

**REMARKS**

Please reconsider this application in view of the above amendments and the following remarks. Applicant thanks the Examiner for carefully considering this application.

**Disposition of Claims**

Claims 1-11 and 13-15 were pending in this application. By way of this reply, independent claims 1 and 9 have been amended to include all of the limitations of claim 6. Thus, claim 6 has been canceled without prejudice or disclaimer. Accordingly, claims 1-5, 7-11, and 13-15 are currently pending in this application. Claims 1 and 9 are independent. The remaining claims depend, directly or indirectly, from claim 1 or 9.

**Claim Amendments**

Independent claims 1 and 9 have been amended to include all of the limitations of claim 6. Accordingly, claim 6 has been canceled without prejudice or disclaimer. Consistent with these amendments, claim 7 has been amended to depend from amended independent claim 1. No new matter has been added by way of these amendments. Further, independent claims 1 and 9 have been amended to specifically recite “the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter.” No new matter has been added by way of these amendments, as support for these amendments may be found, for example, in paragraphs [0004] and [0038] of the publication of the Specification.

**Rejection(s) Under 35 U.S.C. § 103(a)**

Claims 1, 8, 11, and 13 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,441,403 to Chang et al. (hereinafter “Chang”) in view of U.S. Patent No. 4,992,837 to Sakai et al. (hereinafter “Sakai”).

As explained above, independent claim 1 has been amended to include all of the limitations of claim 6, and is therefore believed to be patentable over Chang and Sakai. Accordingly, withdrawal of this rejection is respectfully requested.

Claims 6 and 7 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Sakai and further in view of U.S. Patent Publication No. 2002/0195619 to Makimoto et al. (hereinafter “Makimoto”). As explained above, independent claim 1 has been amended to include all of the limitations of claim 6 and to specifically recite “the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter.” To the extent that the rejection may still apply to the claims as amended, for the reasons set forth below, the rejection is respectfully traversed.

One or more embodiments of the claimed invention are directed to a gallium nitride (GaN)-based compound semiconductor device. With reference to Figures 1 and 2, for example, the GaN-based compound semiconductor device has a GaN-based light emitting member 24 and a buffer layer 22. The light emitting member 24 further has a multilayer quantum well structure. Specifically, the light emitting member 24 has an InGaN well layer 24b and an AlInGaN barrier layer 24a. The compositional ratio of Al in the AlInGaN barrier layer 24a is 14% or greater and 40% or smaller, and the compositional ratio of In in the AlInGaN barrier layer 24a is 0.1% or greater and 5% or smaller. As a result, the light emission efficiency of the GaN-based compound

semiconductor device becomes 2.6 times greater, and the GaN-based compound semiconductor device can provide a light emission whose wavelength is 375nm or shorter (*see, e.g.*, publication of the Specification, paragraphs [0004] and [0032]).

Accordingly, amended independent claim 1 requires, in part, “a compositional ratio of Al in the AlInGa<sub>N</sub> barrier layer is 14% or greater and 40% or smaller, and a compositional ratio of In in the AlInGa<sub>N</sub> barrier layer is 0.1% or greater and 5% or smaller” and “the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter.”

In contrast, Makimoto fail to show or suggest at least the above limitations. In fact, Makimoto only teaches when AlInGa<sub>N</sub> is applied to Makimoto’s nitride semiconductor device, special care is necessary. Specifically, Makimoto teaches that a skilled artisan would consider the fact that the higher the ratio of Al composition is, the wider the bandgap of the AlInGa<sub>N</sub> is, whereas the higher the ratio of In composition is, the narrower the bandgap of the AlInGa<sub>N</sub> is than that of GaN (*see* Makimoto, paragraph [0112]). Thus, it would be clear to a skilled artisan that Makimoto is completely silent with respect to the specific compositional ratios of Al and In as claimed.

Makimoto also cannot show or suggest at least “the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter,” as required by amended independent claim 1. In fact, Makimoto is completely silent with respect to a wavelength that is emitted by the device of Makimoto. Further, as explained in the present Specification, a skilled artisan at the time of the present invention would have recognized that realizing a light whose wavelength is 375 nm or shorter results in reducing an efficiency of the light emission (*see, e.g.*, publication of the Specification, paragraphs [0002] and [0003]).

Therefore, Makimoto necessarily cannot show or suggest at least “the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter” and “the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter,” as required by amended independent claim 1.

The Examiner alleges that Makimoto teaches adjusting the content of Al and In in an AlInGaN layer, and, thus, the specific compositional ratios of Al and In as claimed is a result effective variable (*see* pending Office Action, at page 6). Applicant respectfully disagrees.

MPEP makes it clear that “[a] particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation.” *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). Applicant respectfully asserts that the specific compositional ratios of Al and In as claimed is *not a result effective variable*.

In fact, Makimoto is focused on solving problems that electrons injected from an emitter cannot reach a collector through a base and that it is difficult for a light emitting device to inject electrons or holes into an active layer because of a space charges in a graded layer (*see* Makimoto, paragraphs [0014]-[0017]). Thus, a skilled artisan would readily recognize that the problems of Makimoto is irrelevant to the results of the claimed invention, and, therefore, the skilled artisan would not recognize the result that the claimed invention achieves 2.6 times greater efficiency of a light emission whose wavelength is 375 nm or shorter as a *result effective variable* from the teachings of Makimoto.

Furthermore, Applicant respectfully asserts that the invention recited in amended independent claim 1 achieves *new and unexpected results* in that a GaN-based compound semiconductor device as recited in the claims emits a light that has a *wavelength between 340-375 nm* (see publication of the Specification, column 4, paragraph [0038]). As described in the present Specification, a skilled artisan at the time of the present invention would have recognized that, in view of prior art, “fundamentally, when InGaN is used as the light emitting layer, *light emission of 363 nm or shorter cannot be achieved*” (see publication of the Specification, column 1, paragraph [0003]). Also, a skilled artisan at the time of the present invention would have recognized that achieving a light whose wavelength is 375 nm or shorter results in reducing an efficiency of the light emission (see, e.g., publication of the Specification, paragraphs [0002] and [0003]).

MPEP makes it clear that Applicant can rebut a *prima facie* case of obviousness based on a claimed invention by showing that there are new and unexpected results relative to the prior art (see MPEP § 2144.05). In view of above, Applicant respectfully asserts that the invention recited in amended independent claim 1 achieves new and unexpected results relative to the prior art.

Further, amended independent claim 1 recites a novel and non-obvious specific range that solves a *long-felt need* that was left unresolved by the prior art. As described in the present Specification, a skilled artisan at the time of the present invention would have recognized that, in view of prior art, “*there have been a active efforts to develop LEDs having a short wavelength of 375 nm or shorter or having an ultraviolet (UV) wavelength. Demand for such short wavelength LEDs is very strong*” (see publication of the Specification, column 1, paragraph [0003]). However, as explained above, “fundamentally, when InGaN is used as the light emitting layer,

*light emission of 363 nm or shorter cannot be achieved*” (see publication of the Specification, column 1, paragraph [0003]). Further, to realize a light emission whose wavelength is 375 nm or shorter results in reducing an efficiency of the light emission (see, e.g., publication of the Specification, paragraphs [0002] and [0003]). Thus, the invention recited in amended independent claim 1 addresses this long-felt need (among other things).

MPEP requires the Examiner to consider such a long-felt need as a relevant factor in any obviousness determination (see MPEP § 2141). Applicant respectfully asserts that amended independent claim 1 recites a novel and non-obvious specific range that solves a long-felt need that was left unresolved by the prior art.

In addition, Chang and Sakai fail to show or suggest that which Makimoto lacks. This is evidenced by the fact that Sakai is only relied upon by the Examiner to supply a use of a strained layer superlattice clad layer (see pending Office Action, at page 2). Also, the Examiner acknowledges that Chang fails to show or suggest at least “a compositional ratio of Al in the AlInGa<sub>N</sub> barrier layer is 14% or greater and 40% or smaller, and a compositional ratio of In in the AlInGa<sub>N</sub> barrier layer is 0.1% or greater and 5% or smaller,” which was recited in claim 6 and now is incorporated into amended independent claim 1 (see pending Office Action, at page 5).

In view of above, Makimoto, Chang, and Sakai, whether taken separately or in combination, fail to show or suggest the invention as recited in amended independent claim 1. Further, the invention recited in amended independent claim 1 achieves new and unexpected results and a novel, and amended independent claim 1 recites non-obvious specific range that solves a long-felt need that was left unresolved by the prior art. Thus, amended independent

claim 1 is patentable over Makimoto, Chang, and Sakai. Dependent claims are allowable for at least same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Claim 2 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Sakai and further in view of Makimoto.

As explained above, Makimoto, Chang, and Sakai, whether taken separately or in combination, fail to show or suggest the invention as recited in amended independent claim 1. Claim 2, dependent from amended claim 1, is allowable for at least the same reasons.

Claims 4 and 5 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Sakai and further in view of U.S. Patent No. 5,543,638 to Nettelblatt et al. (hereinafter "Nettelblatt").

As explained above, Chang and Sakai, whether taken separately or in combination, fail to show or suggest the invention as recited in amended independent claim 1.

Nettelblatt fails to show or suggest that Chang and Sakai lack. This is evidenced by the fact that Nettelblatt is relied upon only to supply the thickness of the InGaN well layer as required by claims 4 and 5 (*see* pending Office Action, at page 4).

In view of above, Chang, Sakai, and Nettelblatt, whether taken separately or in combination, fail to show or suggest the invention as recited in amended independent claim 1. Claims 4 and 5 are allowable at least by virtue of their dependency.

Claims 9 and 10 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Sakai and further in view of Makimoto. As explained above, independent claim 9 has been amended to include all of the limitations of claim 6 and to specifically recite "the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter."

To the extent that the rejection may still apply to the claims as amended, for the reasons set forth below, the rejection is respectfully traversed.

Amended independent claim 9 requires, in part, “a compositional ratio of Al in the AlInGa<sub>N</sub> barrier layer is 14% or greater and 40% or smaller, and a compositional ratio of In in the AlInGa<sub>N</sub> barrier layer is 0.1% or greater and 5% or smaller” and “the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter.”

In view of the similarity between the limitations of amended independent claim 9 and the limitations discussed above with respect to amended independent claim 1, Applicant respectfully submits that the foregoing arguments as to the patentability of amended independent claim 1 also demonstrate the patentability of amended independent claim 9. As such, it is respectfully submitted that amended independent claim 9 are patentably distinguishable over the cited references at least for reasons analogous to those presented above. Claim 10 is allowable for at least same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Claims 14 and 15 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Sakai and further in view of U.S. Patent Publication No. 2003/0047744 to Yanamoto (hereinafter “Yanamoto”).

As explained above, Chang and Sakai, whether taken separately or in combination, fail to show or suggest the invention as recited in amended independent claim 9.

Yanamoto fails to show or suggest that Chang and Sakai lack. This is evidenced by the fact that Yanamoto is only relied upon to supply a use of alternating AlGa<sub>N</sub> and GaN clad layers (*see* pending Office Action, at page 9).

In view of above, Chang, Sakai, and Yanamoto, whether taken separately or in combination, fail to show or suggest the invention as recited in amended independent claim 1. Claims 4 and 5 are allowable at least by virtue of their dependency.

## Conclusion

Applicant believes this reply is fully responsive to all outstanding issues and places this application in condition for allowance. If this belief is incorrect, or other issues arise, the Examiner is encouraged to contact the undersigned or his associates at the telephone number listed below. Please apply any charges not covered, or any credits, to Deposit Account 50-0591, Reference No. 08228/071001.

Dated:

Respectfully submitted,

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